

# ON THE GENITAL ARMATURE OF THE FEMALE MOSQUITO

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So far as we have been able to ascertain, very little attention has hitherto been paid to the differential characters of the genital armature of female mosquitoes. In this paper, therefore, we record briefly the results of a preliminary examination we have made of fifty West African species referable to sixteen different genera.

It may be said generally that we have found in most cases well marked differences between distinct genera, but only slight or almost inappreciable ones between species of the same genus. The degree of resemblance is, however, very variable: in some genera, as for example in the genus *Stegomyia*, it is very close; in others, much less so. In some genera, indeed, as in the genus *Mimomyia* and the somewhat heterogeneous genus *Ochlerotatus*, there are such rotatable differences between certain species that they appear to be almost generic.

In making our examinations we have again found pure carbolic acid a valuable reagent. When immersed in this fluid, either with or without previous treatment with caustic potash, the abdomen of a mosquito swells out and becomes transparent, and if mounted under a cover-slip in a hollow on a glass slide, can be rolled over and over, so that every aspect of it can be carefully examined. In fresh or fairly recent preserved specimens, the spermathecae also are expanded by this treatment, so that their precise shape can be determined and accurate measurements made of their various diameters; in old specimens, however, this does not always happen as the spermathecae are collapsed, and may be so much hardened that no procedure which we have hitherto tried will restore their elasticity sufficiently to permit of their subsequent expansion when immersed in carbolic acid.

The figures illustrating this paper are mere outlines, drawn with the aid of a camera lucida, omitting both hairs and scales. It should also be explained that when giving measurements in the text, such as those of the cerci or spermathecae, the length is given first and then the breadth, unless otherwise noted. The following abbreviations are used in the figures.

- t viii, t ix.=Tergite of segment eight, nine.  
 s viii, s ix.=Sternite of segment eight, nine.  
 c. =Cerci.  
 v.p. =Ventral process of the tenth segment.  
 sp. =Spermatheca.

#### GENERAL MORPHOLOGY OF THE FEMALE ARMATURE

*External armature.* The eighth abdominal segment is usually of normal form, and has a well developed tergite and sternite; although most commonly distinct, it is sometimes partially, or even almost completely withdrawn within the seventh segment. The ninth segment, which is small and somewhat modified, is more or less withdrawn within the eighth segment, so that there is on the ventral aspect a small membranous recess in the middle of which opens the genital canal. In this recess, in the middle line immediately above the posterior margin of the eighth sternite, there is also in some species, for example in the genus *Culex*, a clearly defined, tuft-like group of stout setae. The ninth tergite is small, and is usually reduced to a narrow transverse strip of chitin bearing a few hairs, but in some genera is rather more highly developed and is shield-shaped. The genital orifice is supported by ventral sclerites which vary considerably in size and form in different species, and which are usually poorly developed. In the neighbourhood of the genital orifice, but internally and projecting forwards and downwards, is also a supporting framework which in a dorsal or ventral view appears as a more or less U-shaped structure surrounding the vulva on its lateral and posterior sides. This structure is well chitinised in some species, especially in the genus *Culex*. The tenth segment is greatly reduced, and is without either tergite or sternite. It bears dorsally the two cerci, which play a part in the manipulation of the eggs, and ventrally a short median process the function of which is apparently unknown. The cerci are more

or less leaf-like structures, and show a great diversity of size and shape. Most commonly they are short and truncated at their ends, somewhat hollowed on their inner surfaces, and set obliquely, so that their upper margins converge and a full-view of them can be obtained only when the abdomen is in a sub-lateral position. The anus opens on a membranous projection between the cerci.

*Internal armature.* The two ovaries lie one on each side of the abdomen. In recently hatched mosquitoes they are small, but in gravid individuals they occupy the greater part of the lateral and dorsal portions of the abdomen. From each ovary arises a short, wide, muscular oviduct which runs a straight course posteriorly and inwards and meets its fellow of the other side in the middle line to form the common oviduct, a relatively short, wide, muscular tube which lies ventral to the rectum and opens at the genital orifice. Into the common oviduct there opens, a short distance above the genital orifice, the duct of the gluten or mucous gland. This gland is single, and occupies a median ventral position. The spermathecae are situated on the ventral aspect of the eighth segment, and are highly chitinised oval or sub-spherical bodies enclosed in a thick cellular envelope. The chitinised wall is usually more or less pitted with small round or oval areas of thinner chitin which are most commonly grouped round the point of origin of the duct, but may be distributed over the whole surface of the spermathecae. When the spermathecae are viewed by transmitted light these areas appear as light-coloured marks, and are, therefore, referred to as 'pale spots' in the specific descriptions which follow. The ducts of the spermathecae are long and coiled, and open into the common oviduct just before the genital orifice. They are usually chitinised for a short distance only at their commencement, and for the greater part of their length appear to be muscular with an inner lining somewhat resembling a tracheal tube. In those species which have three spermathecae, the middle one is usually the larger and has an independent duct. The ducts of the lateral spermathecae unite about their middles to form a common duct which opens into the common oviduct close to, but apparently not actually in common with the duct of the middle spermatheca. The extremity of the duct of the middle spermathecae may be chitinised for a short distance before entering the common oviduct.

Sub-family *CULICINAE*

## Tribe ANOPHELINI

Genus *Anopheles*

Eight species were examined, all of which possess genitalia of a somewhat similar form. There is in each case a single, large, highly chitinised spermatheca which is sub-spherical in shape, the length being but slightly greater than the breadth. The duct of the spermatheca, which is chitinised for a short distance, arises obliquely, thus forming an acute angle with one side of the body of the spermatheca. On this side, especially near the distal pole and around the base, the chitinous wall of the spermatheca is pitted with

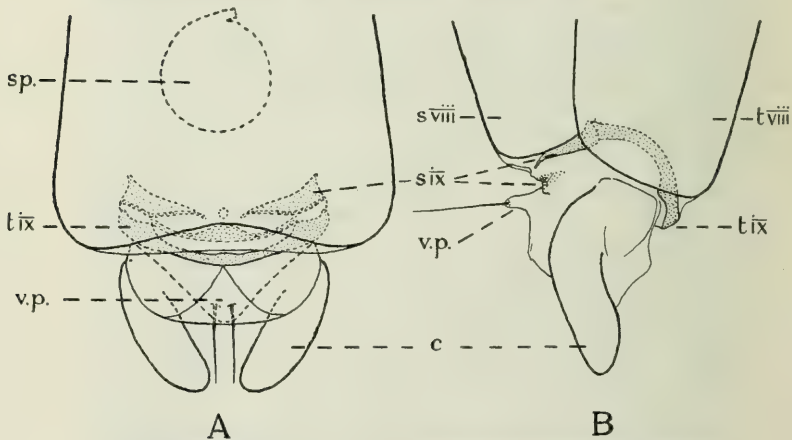


FIG. 1. *Anopheles costalis*, Theo., posterior extremity of abdomen of female. *A*—dorsal view; *B*—lateral view.  $\times$  c. 185.

numerous round or oval areas which by transmitted light appear as pale spots. The form of the spermatheca and the distribution of these pale spots furnish differential points in some species, as also do the characters of the cerci.

*A. costalis*, Theo. (fig. 1). Twenty specimens. Posterior extremity of the abdomen blunt, cerci prominent. The eighth segment not retracted within the seventh; sternite not notched in the



middle line posteriorly. The ninth segment retracted within the eighth, its tergite reduced to a narrow strip of chitin, and its sternite represented by two transverse bars of chitin which are roughly triangular in shape with their apices directed towards the middle line and a more posterior bar which is broadest in the middle line. Cerci (fig. 2 *d*) elongate-ovoid with blunt, rounded ends; length

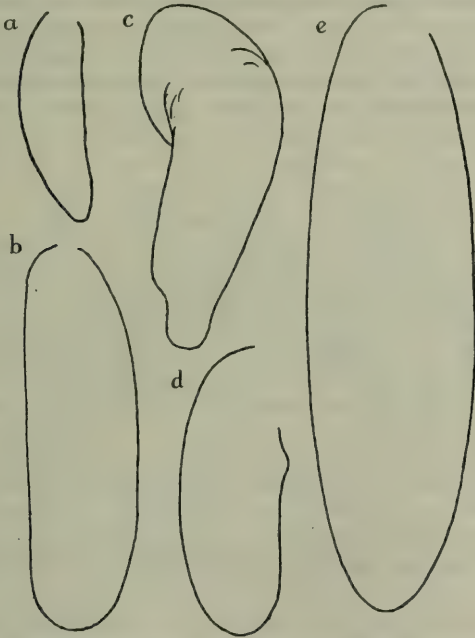


FIG. 2. Cerci, dorso-ventral views of *a*—*Anopheles nili*, Theo.; *b*—*A. squamosus*, Theo.; *c*—*A. mauritanus*, Grp.; *d*—*A. costalis*, Theo., and *e*—*A. pharoensis*, Theo.  $\times$  c. 375.

varying from  $122\mu$  to  $167\mu$ , average  $140\mu$ ; breadth from  $30\mu$  to  $62\mu$ , average  $51\mu$ . Ventral process on the tenth segment small, triangular, not emarginate, bearing two stout bristles near its apex. Spermatheca (fig. 3 *a*) single, large, sub-spherical, the length, which varied from  $95\mu$  to  $133\mu$ , average  $118\mu$ , being slightly greater than the breadth, which varied from  $95\mu$  to  $130\mu$ , average  $112\mu$ . It is

P. 161. Legend beneath fig. 2, for *A. costalis*, Theo., read *A. costalis*, Loew.

well chitinised but has numerous small round or oval areas of thinner chitin, which by transmitted light appear as pale spots, at the base and along one side, namely, the side towards which the duct projects. The duct arises obliquely, and the chitinised portion of it, which is very short and shows a few pale spots, forms an acute angle with the spermatheca; the chitinised wall of the duct lying next to the body of the spermatheca measured from  $8\mu$  to  $19\mu$ , average  $13\mu$ .

*A. marshalli*, Theo. One specimen. Generally similar to *A. costalis*. Cerci rather shorter and relatively broader, elongate-ovoid, with blunt, rounded ends; length about  $100\mu$ , breadth about  $40\mu$ . Spermatheca (fig. 3 *b*) slightly smaller, diameter about  $95\mu$ ;

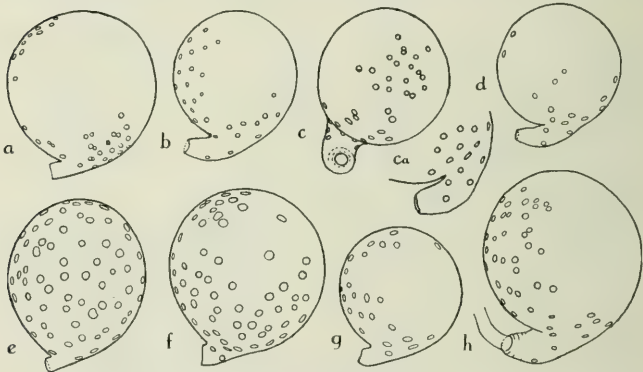


FIG. 3. Spermathecae of a—*Anopheles costalis*, Theo.; b—*A. marshalli*, Theo.; c and ca—*A. funestus*, Giles; d—*A. nili*, Theo.; e—*A. mauritanus*, Grp.; f—*A. pbaroensis*, Theo.; g—*A. squamosus*, Theo., and h—*A. rufipes*, Gough.  $\times c. 250$ .

distribution of pale spots much as in *A. costalis*; the chitinised portion of the duct longer, about  $18\mu$ , somewhat curved and slightly constricted at its end.

*A. funestus*, Giles. Eight specimens. Generally similar to *A. costalis*. Cerci rather more slender; length varying from  $95\mu$  to  $120\mu$ , average  $108\mu$ , breadth from  $27\mu$  to  $36\mu$ , average  $32\mu$ . Spermatheca (fig. 3 *c* and *ca*) varying in length from  $91\mu$  to  $105\mu$ , average  $98\mu$ , and in breadth from  $84\mu$  to  $100\mu$ , average  $93\mu$ ; pale spots somewhat larger, but arranged much as in *A. costalis*;

chitinised portion of the duct long, varying from  $34\mu$  to  $47\mu$ , average  $40\mu$ ; curved and slightly constricted at the end.

*A. nili*, Theo. Two specimens. Generally similar to *A. costalis*. Cerci (fig. 2*a*) smaller and narrower; length about  $105\mu$ , breadth about  $30\mu$ , and distal extremities more conical than rounded. Spermatheca (fig. 3*d*)  $90\mu$  to  $108\mu$  in diameter; pale spots fewer and less distinct; chitinised portion of the duct long,  $30\mu$  to  $50\mu$ , somewhat curved and slightly constricted at its end.

*A. mauritanus*, Grp. Two specimens. Generally similar to *A. costalis*, but more highly chitinised. Cerci larger and of peculiar form (see fig. 2*c*); length about  $180\mu$ , breadth in the middle about  $50\mu$ . Spermatheca (fig. 3*e*) somewhat longer than broad, the diameters in two specimens measuring  $95\mu$  and  $85\mu$ , and  $114\mu$  and  $96\mu$  respectively; pale spots large, conspicuous, and scattered over the whole surface of the spermatheca; chitinised portion of the duct very short, similar to that of *A. costalis*, but shorter.

*A. pharoensis*, Theo. Two specimens. Generally similar to *A. costalis* but more highly chitinised. Cerci (fig. 2*e*) very large, elongate-ovoid; length nearly  $300\mu$ , breadth about  $80\mu$ ; Spermatheca (fig. 3*f*) highly chitinised, almost spherical, diameter about  $110\mu$ ; pale spots large, conspicuous, covering two-thirds of the surface; chitinised portion of the duct very short, similar to that of *A. mauritanus*.

*A. squamosus*, Theo. One specimen. Generally similar to *A. costalis* but more highly chitinised. Cerci (fig. 2*b*) rather large, elongate-ovoid, with rounded ends; length about  $180\mu$ , breadth about  $50\mu$ . Spermatheca (fig. 3*g*) similar to that of *A. costalis* but slightly smaller (diameter  $90\mu$ ) in the single specimen examined, and with the pale spots larger; chitinised portion of the duct as in *A. costalis*.

*A. rufipes*, Gough. Two specimens. Generally similar to *A. costalis* but more highly chitinised. Cerci similar to those of *A. funestus*; length  $130\mu$  to  $150\mu$ , breadth  $30\mu$  to  $50\mu$ . Spermatheca (fig. 3*h*) sub-spherical, very highly chitinised; length  $130\mu$  to  $140\mu$ , breadth  $115\mu$  to  $118\mu$ ; pale spots as in *A. costalis* but rather larger; chitinised portion of the duct long, about  $35\mu$ , curved and slightly constricted at its end.

The eight species examined fall naturally into two groups: four

species, namely, *A. costalis*, *A. mauritanus*, *A. pharoensis* and *A. squamosus*, having only a very short portion, and four, namely, *A. marshalli*, *A. funestus*, *A. nili* and *A. rufipes*, having a considerably longer portion of the duct of the spermatheca chitinised. The species belonging to the first group can readily be distinguished by the arrangements of the pale spots on the spermatheca and by the form of the cerci. The species belonging to the second group can hardly be distinguished by these characters, although small differences between them may be noted, such as the large size of the spermatheca in *A. rufipes*, the feeble development of the pale spots and the rather narrow end to the cerci in *A. nili*, and the rather short and broad cerci in *A. marshalli*.

### Tribe MEGARHININI

#### Genus *Toxorhynchites*

*T. brevipalpis*, Theo. One specimen. Posterior extremity of the abdomen blunt, cerci scarcely projecting; eighth segment not retracted. Sternite and tergite of the ninth segment highly chitinised, each appearing in a ventral view as a strip of chitin bent in the form of an arch with the opening directed anteriorly. Cerci (fig. 4) relatively small, with hatchet-shaped ends; length nearly



FIG. 4. *Toxorhynchites brevipalpis*, Theo., outlines of cerci and (dotted line) ventral process of the tenth segment, dorsal view.  $\times$  c. 185.

300 $\mu$ , breadth 114 $\mu$  at the widest part. Ventral process of the tenth segment bluntly conical, not emarginate, covered with bristles, none of which are, however, exceptionally long. Spermathecae three,

relatively small, highly chitinised, sub-spherical, the middle one rather larger than the other two, diameter about  $110\mu$ ; only the very commencement (about  $3\mu$ ) of the duct is chitinised.

Tribe CULICINI

Genus *Mucidus*

*M. scatophagoides*, Theo. (fig. 5 A). Two specimens. Posterior extremity of the abdomen tapering; the eighth segment sometimes completely withdrawn within the seventh. Sternite of the eighth

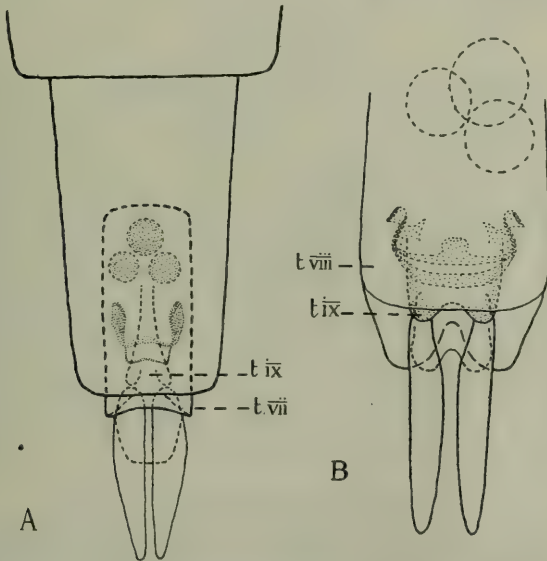


FIG. 5. Posterior extremity of abdomen of female, dorsal view. A—*Mucidus scatophagoides*, Theo.  $\times$  c. 92; B—*Banksinella lineatopennis*, Lud.  $\times$  c. 185. *t viii* and *t ix*—tergites of eighth and ninth segments.

segment deeply cleft posteriorly. Sternite of the ninth segment apparently reduced to narrow bands of chitin forming a double U-shaped loop. Cerci very long and leaf-like, tapering towards the

tips, length about  $350\mu$ , breadth about  $100\mu$ . At the bases of the cerci lies a long, straight plate of chitin, about  $250\mu$  in length, which is produced at its posterior end into two hairy lateral processes, runs directly anteriorly, and tapers gradually. This plate is apparently the ninth tergite. Ventral process on the tenth segment tongue-shaped, bearing a few stout setae, posterior margin broad, not emarginate. Spermathecae three, highly chitinised, sub-spherical or oblate-spheroidal, unequal, the middle one being slightly the largest. In the two specimens examined the diameters of the spermathecae were approximately  $65\mu$ ,  $76\mu$ ,  $65\mu$ , and  $74\mu$ ,  $93\mu$ ,  $74\mu$  respectively. The ducts of the spermathecae are chitinised only at their very commencement (about  $2\mu$ ).

#### Genus *Banksinella*

*B. lineatopennis*, Lud. (fig. 5 B). Three specimens. Genitalia of similar type to those of the genus *Stegomyia*. Posterior extremity of the abdomen tapering; the eighth segment may or may not be withdrawn within the seventh. Sternite of the eighth segment deeply notched posteriorly; tergite and sternite of the ninth segment relatively well developed. Cerci long, leaf-like, tapering towards their tips, somewhat similar to those of *Mucidus scatophagoides*; length about  $220\mu$ , breadth about  $60\mu$ . Ventral process of the tenth segment deeply notched in the middle line posteriorly. Spermathecae three, highly chitinised, sub-spherical (the length being slightly greater than the breadth), and unequal. The right and left spermathecae are about the same size, their diameters being about  $60\mu$ ; the middle one is larger, diameter about  $80\mu$ . The ducts of the spermathecae are chitinised for only a very short distance ( $1\mu$  to  $2\mu$ ) at their commencements.

#### Genus *Stegomyia*

Eight species were examined, all of which possess genitalia of a similar form; indeed, so close were the resemblances, that we were in most cases unable to detect differential points, and such differences as were noted appeared to be of only minor importance.

*S. fasciata*, F. (fig. 6). Ten specimens. Posterior extremity of the abdomen tapering slightly. Eighth segment not, or but slightly withdrawn within the seventh; sternite projecting beyond the

tergite and deeply notched in the middle line posteriorly. Tergite of the ninth segment shield-shaped, the posterior margin produced laterally into conical processes, which are well chitinised and armed with several stout setae. Sternite of the ninth segment represented by a narrow posterior strip of chitin which is arched so that its

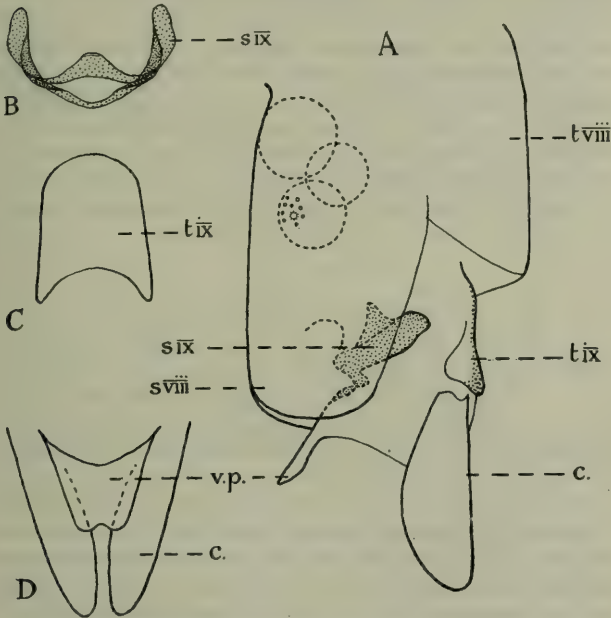


FIG. 6. *Stegomyia fasciata*, F. *A*—posterior extremity of body, lateral view; *B*—ninth sternite, ventral view; *C*—ninth tergite, dorsal view; *D*—cerci and ventral process of tenth segment, ventral view.  $\times$  c. 185.  $t^{\text{viii}}$  and  $t^{\text{ix}}$ —tergites of eighth and ninth segments;  $s^{\text{viii}}$  and  $s^{\text{ix}}$ —sternites of eighth and ninth segments;  $c$ —cerci;  $v.p.$ —ventral process of the tenth segment.

concavity is anterior and is expanded laterally, and a more delicate bar of chitin in front of it, which is broadest in the middle line. Cerci prominent, short and broad, hollowed out on their inner aspects, and inserted obliquely, that is with their broad surfaces converging dorsally; in the ten specimens measured the length



ranged from  $152\mu$  to  $198\mu$ , average  $183\mu$ , and the breadth from  $77\mu$  to  $103\mu$ , average  $85\mu$ . Ventral process of the tenth segment (fig. 7 *a*) with a moderately well developed notch in the middle of its posterior border, and bearing on each side several (about eight) long setae. Spermathecae three, highly chitinised, sub-spherical, the length being usually slightly greater than the breadth. The spermathecae are unequal and somewhat variable in size; the right and left ones are approximately the same size and in the ten specimens measured ranged in length from  $61\mu$  to  $80\mu$ , average  $69\mu$ , and in breadth from  $56\mu$  to  $76\mu$ , average  $63\mu$ ; the middle one is larger and ranged in length from  $84\mu$  to  $95\mu$ , average  $91\mu$ , and in breadth from  $70\mu$  to  $91\mu$ , average  $82\mu$ . A few pale spots similar to those in *Anopheles costalis* are sometimes present round the base. The ducts of the spermathecae are scarcely at all chitinised, at most for a distance of  $2\mu$  to  $4\mu$  at their commencement.

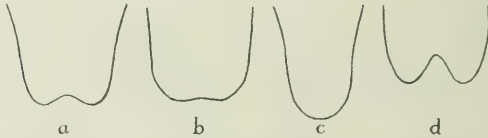


FIG. 7. Ventral process of the tenth abdominal segment, ventral view, of *a*—*Stegomyia fasciata*, F.; *b*—*S. unilineata*, Theo.; *c*—*S. vittata*, Bigot., and *d*—*Ochlerotatus albocephalus*, Theo.  $\times$  c. 250.

*S. apicoargentea*, Theo. One specimen. Very closely resembling *S. fasciata*. In the single specimen examined the only differences noted were that the setae on the posterior angles of the ninth tergite appeared to be longer, that the ventral process of the tenth segment was less deeply notched, and that the spermathecae were rather large, measuring  $84\mu$  by  $80\mu$ ,  $110\mu$  by  $91\mu$ , and  $80\mu$  by  $76\mu$ . These slight differences may be merely variations, and without confirmation from more materials are insufficient to distinguish the species.

*S. dendrophila*, Edw. Two specimens. Apparently indistinguishable from *S. fasciata*.

*S. luteocephala*, Newst. Four specimens. Very similar to *S. fasciata*, the only difference noted being the absence of the notch in the posterior border of the ventral process of the tenth segment.

*S. metallica*, Edw. One specimen. Apparently indistinguishable from *S. fasciata*, but notch in posterior border of the ventral process of the tenth segment shallow, as in *S. unilineata*.

*S. simpsoni*, Theo. One specimen. Apparently indistinguishable from *S. fasciata*, but the notch in the posterior border of the ventral process of the tenth segment is very shallow in the single specimen examined.

*S. unilineata*, Theo. Six specimens. Apparently indistinguishable from *S. fasciata*, but the notch in the posterior border of the ventral process of the tenth segment very shallow (fig. 7*b*), as in *S. simpsoni* but cerci shorter.

*S. vittata*, Bigot. Three specimens. Very similar to *S. fasciata*, but the ventral process of the tenth segment long, tongue-like, without a notch (fig. 7*c*).

#### Genus *Ochlerotatus*

Five species were examined; in all of them the genitalia were somewhat of the same type as those of species of *Stegomyia*. Two of the species, however, showed a remarkable divergence, inasmuch as they possessed only a single, large, spermatheca.

*O. albocephalus*, Theo. Two specimens. Similar to *S. fasciata*, but eighth segment usually more or less retracted within the seventh, eighth sternite more widely notched, cerci rather longer and narrower, length about  $190\mu$ , breadth about  $63\mu$ , ninth tergite smaller, less highly chitinised, notch in the posterior border of the ventral process of the tenth segment much deeper (fig. 7*d*), and chitinised portion of the ducts of the three spermathecae a little longer, about  $4\mu$  to  $7\mu$ .

*O. apicoannulatus*, Edw. One specimen. Similar to *O. albocephalus*, but cerci relatively shorter and broader, length  $134\mu$ , breadth  $65\mu$  in the single specimen examined, and spermathecae (especially the middle one) a little larger but still well within the range of variation found in *S. fasciata*.

*O. domesticus*, Theo. One specimen. Similar to *O. albocephalus*, but eighth sternite more deeply notched, cerci longer, length about  $280\mu$ , breadth about  $68\mu$ , and notch in the ventral process of the tenth segment less deep.

*O. irritans*, Theo. (fig. 8). Seven specimens. General characters similar to those of *O. albocephalus*. Eighth segment usually partially withdrawn within the seventh, but capable of complete protrusion, disclosing a wide membranous junction between the two segments. Eighth sternite slightly longer than the tergite, notch rather shallow. Cerci of usual form: average length  $186\mu$ , average breadth  $83\mu$ .

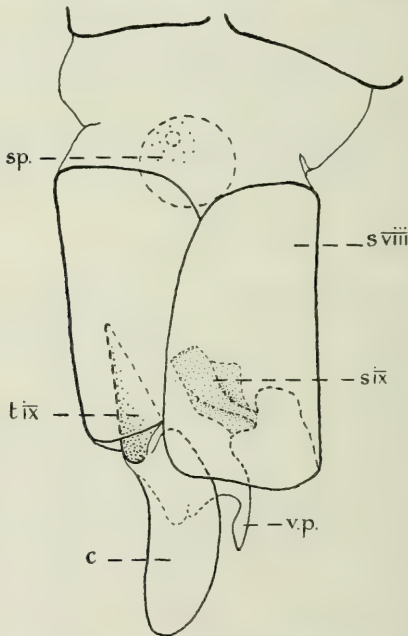


FIG. 8. *Ochlerotatus irritans*, Theo., posterior extremity of abdomen of female, lateral view.  $\times$  c. 185.

Ventral process of the tenth segment deeply notched posteriorly, as in *O. albocephalus*. Spermatheca single, large, sub-spherical; average length  $93\mu$ , breadth  $89\mu$ . There are at the base a number of pale spots, as in *A. costalis*. Duct chitinised for only a short distance, about  $5\mu$ , at its commencement.

*O. punctothoracis*, Theo. One specimen. Apparently almost indistinguishable from *O. irritans*, but the cerci are rather smaller in the single specimen examined and are more pointed at their tips.

Genus *Mansonioides*

*M. africanus*, Theo. (figs. 9 and 10). Eight specimens. Posterior extremity of the abdomen bluntly conical. Eighth segment may be partially retracted within the seventh, tergite narrow, posterior margin armed with a row of strong recurved teeth arranged as shown in the figure (fig. 9), the middle group composed of seven, or more commonly nine teeth, the central one being the longest, the two lateral groups of from five to seven teeth; sternite much longer than the tergite, and prolonged on each side posteriorly as a wide flap which is deeply notched. Ninth segment much reduced, the tergite represented by a narrow arch of chitin, and the sternite by the usual transverse sclerites, which are rather poorly developed. Cerci rather short with their narrowest diameter directed dorso-ventrally, slightly concave dorsally, and ending in a rather sharp tip; length variable, average about  $192\mu$ , middle lateral breadth about  $90\mu$ . Ventral process of the tenth segment very deeply cleft in the middle line posteriorly. Spermathecae three, two large and very highly chitinised, and one very small and feebly chitinised. The two large spermathecae are sub-equal and sub-spherical; average length  $137\mu$ , breadth  $125\mu$ . They have a slight bulge near the point of origin of the duct (fig. 13 A), and there are numerous small pale spots at the base. The ducts are chitinised for only a short distance (about  $10\mu$ ) at the commencement. The small spermatheca is sub-spherical, length about  $29\mu$ , breadth about  $28\mu$ , it is usually feebly and incompletely chitinised, its base being membranous, and is difficult to find if the abdomen is incompletely cleared, and may for this reason be overlooked. Its duct joins the duct of one of the large spermathecae, so that it clearly represents an ill-developed lateral spermatheca.

*M. uniformis*, Theo. Five specimens. As in *M. africanus*, but the lateral flaps of the eighth sternite are not notched. In the five specimens examined it was also noted that the teeth in the lateral groups on the dorsum of the eighth segment were rather more variable and numbered from three to six, and that the small

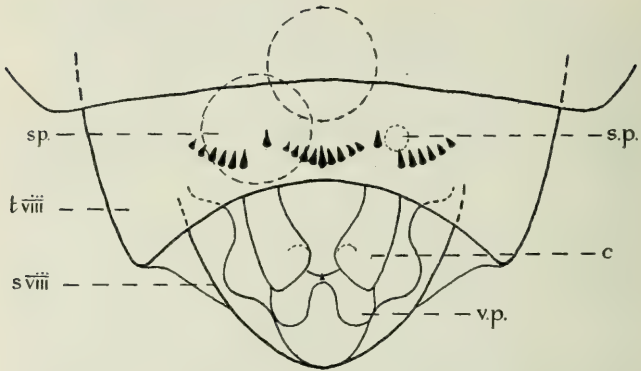


FIG. 9. *Mansonioides africanus*, Theo., posterior extremity of abdomen of female, dorsal view.  $\times$  c. 150.

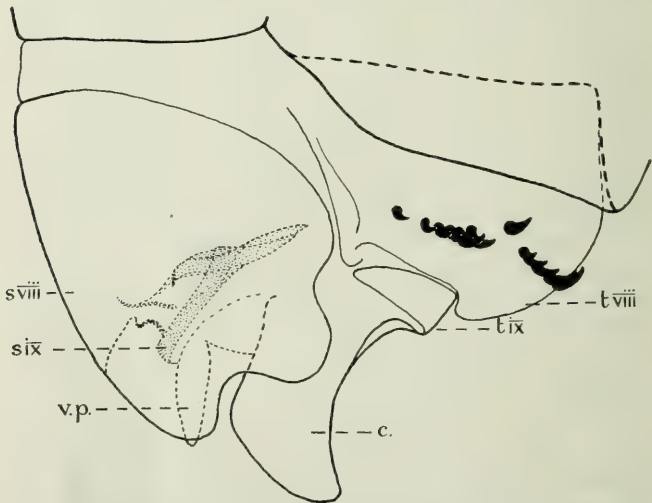


FIG. 10. *Mansonioides africanus*, Theo., posterior extremity of abdomen of female, lateral view.  $\times$  c. 150.

spermatheca was sometimes rather large, in one instance measuring  $65\mu$  by  $53\mu$ ; these latter differences are probably not specific.

### Genus *Aedomyia*

*Aedo. africana*, Nev.-Lem. (figs. 11 and 12). Two specimens. Similar to *Anopheles*. Posterior extremity of the abdomen blunt,

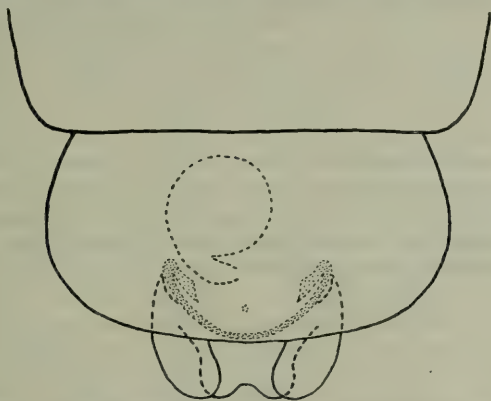


FIG. 11. *Aedomyia africana*, N. L., posterior extremity of abdomen of female, dorsal view.  $\times c. 185$ .

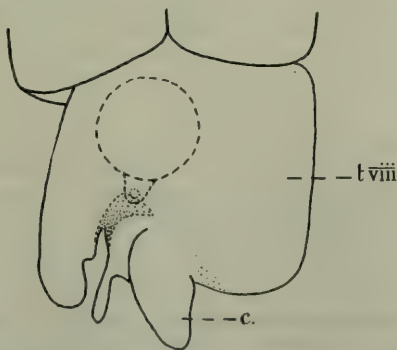


FIG. 12. *Aedomyia africana*, N. L., posterior extremity of abdomen of female, lateral view.  $\times c. 185$ .

P. 173. Legends beneath figs. 11 and 12, for *Aedomyia africana* read *Aedomyia africana*.

cerci not prominent. Eighth segment not withdrawn within the seventh; sternite with a shallow notch. Ninth segment much reduced, feebly chitinised. Cerci short and broad, with blunt, rounded ends; length  $118\mu$ , breadth  $65\mu$ . Ventral process of the tenth segment short and broad with a wide notch in its posterior border, bearing on each side several stout setae. Spermatheca single, very highly chitinised, resembling that of *A. funestus*; length  $106\mu$ , breadth  $97\mu$ , length of the chitinised portion of the duct  $45\mu$ ; the whole spermatheca is sparsely dotted with pale spots, which, however, are small and are most numerous at the base.

#### Genus *Taeniorhynchus*

*T. aurites*, Theo. (fig. 13, B to D). One specimen. In some respects similar to *Mansonioides*. Eighth segment only slightly withdrawn from the seventh and capable of complete protrusion; sternite long, not notched, tergite short, without teeth. Ninth segment reduced, much as in *Mansonioides*. Cerci (fig. 13 B and C)

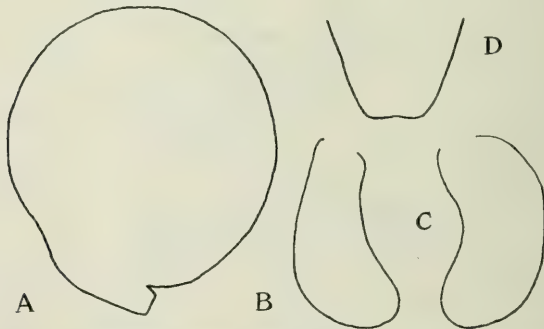


FIG. 13. *A*—*Mansonioides africanus*, Theo., spermatheca;  $\times c. 375$ . *B*—*Taeniorhynchus aurites*, Theo., outline of one of the cerci in ventral view, and *C*—in lateral view; and of *D*—ventral process of the tenth segment;  $\times c. 185$ .

curved dorsally, short, broad, with rounded extremities; length  $182\mu$ , breadth  $80\mu$ . Ventral process of the tenth segment hardly at all notched in the middle line posteriorly (fig. 13 D). Spermathecae three, rather poorly chitinised, sub-spherical, large, unequal; in the single specimen examined they were not fully expanded, but, so far



as could be judged, their diameters were respectively about  $100\mu$ ,  $115\mu$ , and  $122\mu$ . A short portion of the commencement of the ducts is feebly chitinised.

### Genus *Culex*

Twelve species were examined, all of which possess genitalia of a very similar form, so that points of distinction, when found, are but slight and sometimes difficult to detect. In all the species the posterior extremity of the abdomen is blunt, the eighth sternite notched posteriorly, and the cerci relatively small, short, broad, and obliquely set. On the lining membrane, just below the posterior border of the eighth sternite, is a tuft-like group of more or less stout setae. The U-shaped structure surrounding the vulva is well chitinised. The ventral process of the tenth segment is short, occasionally notched, and not very hairy. There are three spermathecae, which are usually oval, and their ducts are chitinised for only a short distance. Points of distinction between species appeared to be furnished by all the above structures. It may be mentioned here that the species belonging to the Genera *Culiciomyia*, *Eumelanomyia*, and *Micraedes*, which we have examined, also possess genitalia of the same type.

*C. fatigans*, Wied. (figs. 14 and 15). Ten specimens. Posterior extremity of the abdomen blunt, cerci not very prominent. Eighth segment not withdrawn within the seventh, sternite prolonged posteriorly beyond the tergite, and shallowly notched. From the middle of the membrane lining the posterior border of the eighth sternite arises a tuft-like group of about ten rather stout setae. Ninth segment, as usual, much reduced; tergite a narrow strip, broadest laterally and rather feebly chitinised. Ventrally there is a horseshoe-shaped strip of chitin, open anteriorly, enclosing the vulva, and just posterior to it a wider arch of chitin, from the lateral portions of which rather broad but feebly chitinised plates project inwards. Cerci set slightly obliquely, concave internally, short and broad, with truncated ends; in the ten specimens measured, length from  $137\mu$  to  $170\mu$ , average  $150\mu$ , and breadth from  $80\mu$  to  $91\mu$ , average  $85\mu$ . Ventral process of the tenth segment (fig. 17 *b*) without a notch, bearing at its apex a few stout setae, and on the ventral aspect a few (two or three on each side) smaller ones.

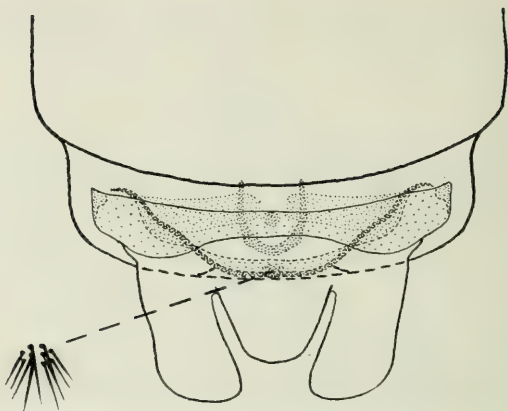


FIG. 14. *Culex fatigans*, Wied., posterior extremity of abdomen of female, dorsal view.  
 X c. 185.

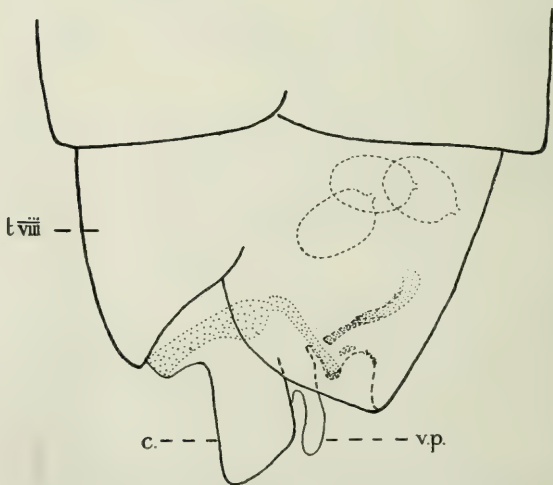


FIG. 15. *Culex fatigans*, Wied., posterior extremity of abdomen of female, lateral view.  
 X c. 185.

Spermathecae (fig. 16 *c*) three, very highly chitinised, sub-equal, the middle one being slightly the largest; in the ten specimens measured the length ranged from  $72\mu$  to  $99\mu$ , average  $84\mu$ , and the breadth from  $55\mu$  to  $76\mu$ , average  $63\mu$ . They are somewhat variable in shape but are usually oval, sometimes almost sub-spherical, and commonly the base is rather broad and the apex narrowed so that they resemble a bee-hive. At the base there are a few 'pale spots.' The chitinised portion of the ducts is short, conical, and in the specimens measured ranged in length from  $6\mu$  to  $11\mu$ , average  $8\mu$ .

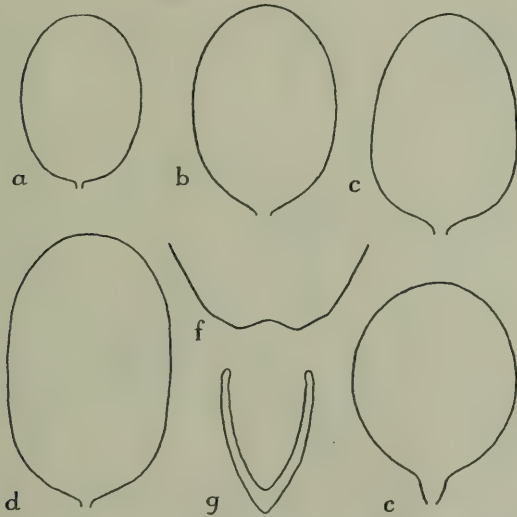


FIG. 16. Outlines of spermathecae of *a*—*Culex insignis*, Cart.; *b*—*C. annulioris*, Theo.; *c*—*C. fatigans*, Wied.; *d*—*C. consimilis*, Newst., and *e*—*C. duttoni*, Theo.; and of *f*—the ventral process of the tenth segment, and *g*—the chitinous hoop round the vulva, of *C. annulioris*, Theo. All  $\times c. 375$ .

*C. annulioris*, Theo. One specimen. As in *C. fatigans*, but the inner chitinous bar enveloping the vulva (fig. 16 *g*) is narrower, almost V-shaped, and the ventral process of the tenth segment is shallowly notched and bears four or five small setae on each side on its ventral aspect (fig. 17 *d*). The spermathecae (fig. 16 *b*) are

highly chitinised, sub-equal, oval; length  $99\mu$ , breadth  $68\mu$ , the chitinised portion of the ducts very short, about  $2\mu$ .

*C. consimilis*, Newst. One specimen. As in *C. fatigans*, but the spermathecae are rather larger (fig. 16*d*). They are highly chitinised, a rather long, oval shape, and not narrowed at the apex; in the specimen examined the middle one measured  $137\mu$  in length by  $84\mu$  in breadth, and the chitinised portion of its duct was about  $7\mu$  long, and in the other two spermathecae the corresponding

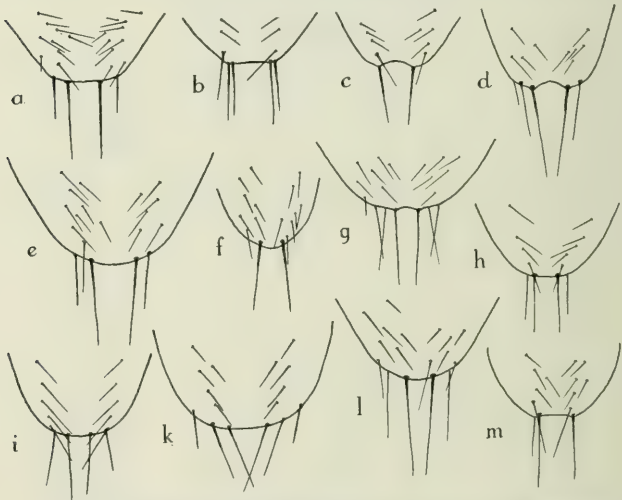


FIG. 17. Ventral process of the tenth segment, ventral view of a—*Culex consimilis*; b—*C. fatigans*; c—*C. decens*; d—*C. annulioris*; e—*C. duttoni*; f—*C. insignis*; g—*C. pruina*; h—*C. quasigelidus*; i—*C. rima*; k—*C. thalassius*; l—*C. tigripes* var. *fuscus*; and m—*C. tritaeniorhynchus*.  $\times 250$ .

measurements were  $129\mu$ ,  $80\mu$ , and  $4\mu$  respectively. The ventral process of the tenth segment (fig. 17*a*) is more hairy than in *C. fatigans*, and bears about nine small setae on each side on its ventral aspect.

*C. decens*, Theo. Twelve specimens. Similar to *C. fatigans*, but in the specimens examined the cerci were rather more prominent, length about  $160\mu$ , breadth about  $70\mu$ ; the tuft of setae on the lining

membrane of the posterior end of the eighth sternite usually rather larger, composed of about a dozen setae; chitinous loop enclosing the vulva not so wide, more U-shaped; the ventral process of the tenth segment (fig. 17 *c*) with a shallow notch, small setae on ventral aspect rather variable, from three to nine on each side; and the spermathecae not so highly chitinised, a little larger, average length  $90\mu$ , breadth  $68\mu$ .

*C. duttoni*, Theo. Two specimens. Generally similar to *C. fatigans*. Tuft of setae on the lining membrane of the eighth sternite rather larger, composed of twelve setae; and ventral process of tenth segment (fig. 17 *e*) more hairy, bearing about six to nine small setae on each side on its ventral aspect. Cerci short and broad; length about  $175\mu$ , breadth about  $115\mu$ . Spermathecae (fig. 16 *e*) very highly chitinised, sub-spherical, the middle one slightly the largest; average length about  $85\mu$ , average breadth about  $77\mu$ , the chitinised portions of the ducts conical, rather long, average length about  $15\mu$ .

*C. insignis*, Carter. One specimen. Generally similar to *C. fatigans*. Eighth sternite more deeply notched posteriorly; and ventral process of the tenth segment (fig. 17 *f*) more conical and more hairy, bearing about six or seven small setae on each side on its ventral aspect. Chitinised bar encircling the vulva rather strong and thick, and omega-shaped. Tuft of setae on the lining membrane of the eighth sternite rather small, composed of eight setae. Cerci rather small and curved dorsally; length  $114\mu$ , breadth  $57\mu$ . Spermathecae (fig. 16 *a*) very highly chitinised, oval, the middle one measuring about  $95\mu$  by  $68\mu$ , and the lateral ones  $84\mu$  by  $57\mu$ ; the chitinised portion of the ducts is short ( $5\mu$  to  $6\mu$ ) and narrow ( $4\mu$ ).

*C. pruina*, Theo. One specimen. Apparently almost indistinguishable from *C. fatigans*, but in the single specimen examined the chitinous loop enclosing the vulva was rather narrower, as in *C. annulioris*, and the spermathecae were not so heavily chitinised, more regularly oval, and longer, having a length of about  $105\mu$ , breadth about  $80\mu$ , and the chitinised portion of the ducts about  $6\mu$ . Small setae on the ventral aspect of the ventral process of the tenth segment (fig. 17 *g*) rather more numerous, about six or seven on each side.

*C. quasigelidus*, Theo. One specimen. As in *C. fatigans*, but in the single specimen examined the loop of chitin enclosing the vulva is more V-shaped, and the spermathecae are rather larger, the middle one measuring  $103\mu$  by  $72\mu$ , the lateral ones  $91\mu$  by  $69\mu$ , and the ducts being short,  $4\mu$  and  $2\mu$  respectively.

*C. rima*, Theo. One specimen. Closely resembling *C. insignis*. In the single specimen examined the cerci were small and curved dorsally, as in *C. insignis*, and the apices of the spermathecae were broad and not narrowed as they often are in *C. fatigans*. The eighth sternite also appeared to be more deeply notched than in *C. fatigans*, and the ventral process of the tenth segment (fig. 17 *i*) more hairy, bearing a row of about five small setae on each side on the ventral aspect.

*C. thalassius*, Theo. Seven specimens. Similar to *C. fatigans*, but loop of chitin enclosing the vulva rather narrower posteriorly, and spermathecae more regularly oval, and in some specimens a little larger ( $103\mu$  by  $68\mu$  in one). Small setae on the ventral aspect of the ventral process of the tenth segment (fig. 17 *k*) rather more numerous, about five on each side.

*C. tigripes*, Grp., var. *fuscus*, Theo. Three specimens. Very highly chitinised. Generally similar to *C. fatigans*, but larger. Cerci about  $180\mu$  by  $105\mu$ . Spermathecae very highly chitinised, shaped as in *C. fatigans*, the middle one the larger, about  $110\mu$  by  $85\mu$ , the lateral ones about  $97\mu$  by  $76\mu$ ; the chitinised portion of the ducts is about  $8\mu$  long. The tuft of setae on the lining membrane of the eighth sternite is rather larger than in *C. fatigans*. The ventral process of the tenth segment (fig. 17 *l*) is not notched, and is rather more conical and hairy than in *C. fatigans*, there being about six small setae on each side on the ventral aspect.

*C. tritaeniorhynchus*, Giles. Two specimens. Apparently indistinguishable from *C. fatigans*, but the spermathecae are, perhaps, a little more regularly oval, and the ventral process of the tenth segment (fig. 17 *m*) rather more hairy, having four or five small setae on each side on its ventral aspect.

The genitalia of the twelve species examined were so much alike that they could be distinguished, if at all, only by means of minute differences, which in some cases cannot be accepted as of specific value owing to the materials being insufficient to exclude the error

due to the natural range of variation. Judging solely from the specimens we have examined, however, points of distinction appeared to be present in the size of the cerci, the shape and size of the spermathecae, the shape of the chitinised hoop round the vulva, the shape of the ventral process of the tenth segment, and the number of small setae (not including the larger setae near the apex) on the ventral aspect of this process.

From all the other species examined *C. duttoni* is readily distinguished by the sub-spherical shape of the spermathecae and the relatively long chitinised portion of the ducts, and *C. consimilis* by the large size of its oval spermathecae and the relatively numerous small setae (about nine on each side) on the ventral aspect of the ventral process of the tenth segment. Two other species, *C. annulioris* and *C. decens*, may, perhaps, be separated by the fact that in them the ventral process of the tenth segment is notched; and *C. tigripes* may be recognised by its size. Other points that may be of systematic value, such as the small size of the cerci in *C. rima* and *C. insignis*, and the scantiness of the hairs on the ventral process of the tenth segment in *C. fatigans* and *C. quasi-gelidus*, can be confirmed only by further experience.

#### Genus *Culiciomyia*

*C. nebulosa*, Theo. Five specimens. Genitalia of the same type as in the genus *Culex*, and very similar to those of *C. fatigans*, from which they appeared to differ only in having shorter cerci (about  $115\mu$  by  $72\mu$ ), and in the ventral process of the tenth segment being shallowly notched and slightly more hairy, having about five small setae on each side on the ventral aspect. The spermathecae are also rather larger and less highly chitinised; the average measurements of the middle one being, length  $99\mu$ , breadth  $69\mu$  (one specimen measuring  $110\mu$  by  $72\mu$ ), and the lateral ones, length  $85\mu$ , breadth  $63\mu$ ; the chitinised portions of the ducts measure about  $7\mu$  in length.

#### Genus *Eumelanomyia*

*E. inconspicua*, Theo. Three specimens. Genitalia of the same type as in the genus *Culex*. Posterior extremity of the abdomen blunt, cerci not prominent, seldom projecting beyond the



eighth sternite. Tuft on the lining membrane of the eighth sternite small, composed of eight not very strong setae. Ninth segment as in *C. fatigans*, but loop enclosing the vulva very feebly chitinised. Cerci small, broad, extremities directed inwards; length about  $105\mu$ , greatest lateral breadth about  $50\mu$ . Ventral process of the tenth segment not notched, bearing a few hairs, none of which are very strong. Spermathecae three, oval, rather feebly chitinised, the middle one slightly the largest; average length about  $88\mu$ , breadth  $65\mu$ , the chitinised portion of the ducts short, about  $7\mu$ .

#### Genus *Micraedes*

*M. inconspicuus*, Theo. One specimen. Genitalia of the *Culex* type. Posterior extremity of the abdomen blunt, cerci not prominent. Eighth segment not retracted within the seventh; sternite with a shallow notch posteriorly. Ninth segment reduced as usual. Ventrally there is a small U-shaped bar of chitin enclosing the vulva, and more posteriorly a second strip of chitin forming a transverse arch. From the lining of the posterior part of the eighth sternite, in the middle line, there projects backwards a tuft-like group of eight (four pairs) stout setae. Cerci short and broad, with truncated extremities; length  $76\mu$ , breadth  $45\mu$ . Ventral process of the tenth segment projecting a little beyond the cerci, broad, very slightly notched, and bearing on each side a few rather feebly chitinised setae, two of which, one apical and one slightly dorsal, are rather large. Spermathecae three, relatively large, moderately well chitinised, oval, and sub-equal; length about  $57\mu$ , breadth about  $46\mu$ . The chitinised commencements of the ducts are conical and rather long, about  $10\mu$ .

#### Genus *Mimomyia*

*M. splendens*, Theo. (fig. 18, A and B). Three specimens. Posterior extremity of the abdomen bluntly conical, cerci rather prominent. Eighth segment not withdrawn within the seventh. Ninth segment much as usual; no U-shaped loop of chitin enclosing the vulva. Cerci of the usual form, obliquely set, rather small, length about  $115\mu$ , lateral breadth about  $65\mu$ . Ventral process of the tenth segment reaching posteriorly as far as the cerci, broad, very

hairy, apically and ventrally, and deeply notched. Spermatheca single, highly chitinised, sub-spherical, and relatively very large, diameter about  $105\mu$  to  $115\mu$ ; there are numerous pale spots at the base, and almost no part of the duct is chitinised.

*M. mimomyiaformis*, Newst. Two specimens. Similar to *M. splendens*, but in the specimens examined the cerci were very short and broad, length  $95\mu$ , lateral breadth  $72\mu$ , and the ventral process of the tenth segment projected posteriorly beyond the cerci and was only feebly notched (fig. 18 c).

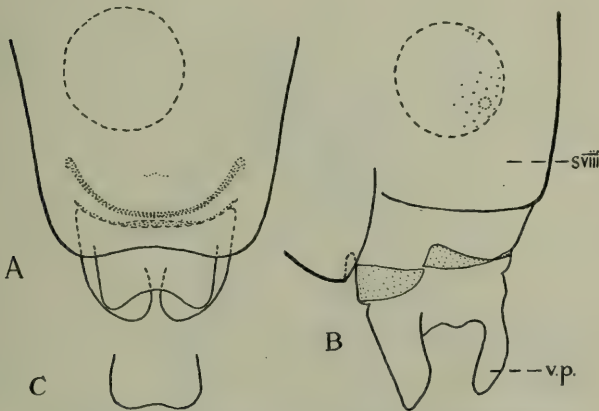


FIG. 18. *Mimomyia splendens*, Theo., posterior extremity of abdomen of female. *A*—ventral view; *B*—lateral view.  $\times$  c. 185. *Mimomyia mimomyiaformis*, Newst.; *C*—ventral process of the tenth segment, ventral view.  $\times$  c. 185.

*M. plumosa*, Theo. (fig. 19). One specimen. Genitalia unlike those of the two preceding species. Chitinisation of the ninth sternite rather strong, but there is no loop enclosing the vulva. Cerci obliquely set as usual, appearance varying greatly with the position: in a ventral view they are truncated, in a lateral view they are cone-shaped with a rather pointed extremity, and in sub-lateral view (the lateral aspect of the cerci) they are short and broad, about  $150\mu$  by  $115\mu$ , with their dorsal extremities prolonged into a

process. Ventral process of the tenth segment large, very hairy, deeply notched posteriorly (fig. 19 B). Spermathecae three, highly chitinised, sub-spherical to oval, the middle one the largest and measuring about  $148\mu$  by  $137\mu$ , the lateral ones smaller, about  $122\mu$  by  $106\mu$ ; practically no part of the ducts is chitinised.

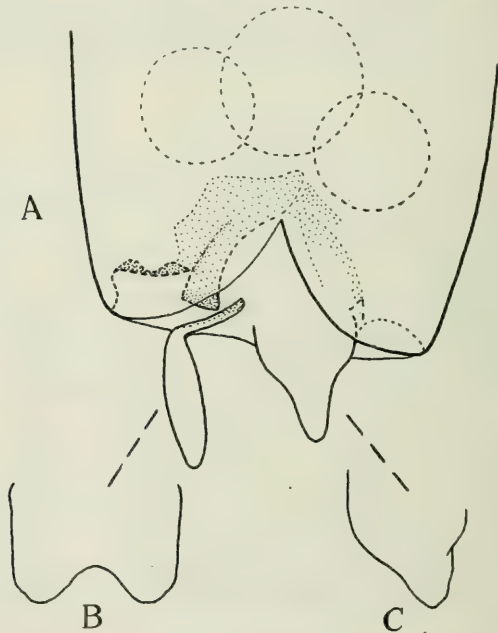


FIG. 19. *Mimomyia plumosa*, Theo. A—posterior extremity of abdomen of female, lateral view; B—ventral process of the tenth segment, ventral view; and C—one of the cerci, sub-lateral view.  $\times$  c. 185.

#### Genus *Uranotaenia*

*U. balfouri*, Theo. One specimen. Very small, posterior extremity of the abdomen bluntly conical, the terminal segments not so far retracted as usual. Cerci (fig. 20 B) very short, broad; length

about  $60\mu$ , breadth about  $45\mu$ . Ventral process of the tenth segment about as long as the cerci, broad, without a notch and bearing a few but no very large setae. Spermatheca single, sub-

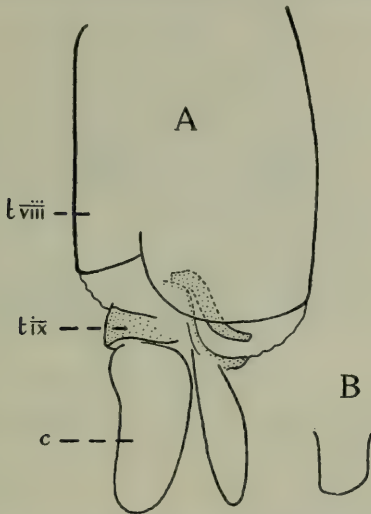


FIG. 20. *A*—*Uranotaenia annulata*, Theo., posterior extremity of abdomen of female, lateral view.  $\times$  c. 185. *B*—*Uranotaenia balfouri*, Theo., one of the cerci, lateral view.  $\times$  c. 185.

spherical, length about  $91\mu$ , breadth about  $84\mu$ ; only the very commencement of the duct is chitinised.

*U. annulata*, Theo. (fig. 20 A). One specimen. Generally similar to *U. balfouri*, but larger. Cerci rather long, with bluntish ends; length about  $170\mu$ , breadth about  $68\mu$ . Ventral process of the tenth segment nearly as long as the cerci, without a notch, bearing numerous setae, those at the apex being large. Spermatheca single, sub-spherical, length  $80\mu$ , breadth  $76\mu$ ; practically no part of the duct (which is long and narrow) is chitinised.

#### Tribe SABETHINI

#### Genus *Eretmopodites*

*E. chrysogaster*, Grah. (figs. 21 and 22). Six specimens. Very highly chitinised. Posterior extremity of the abdomen blunt, cerci

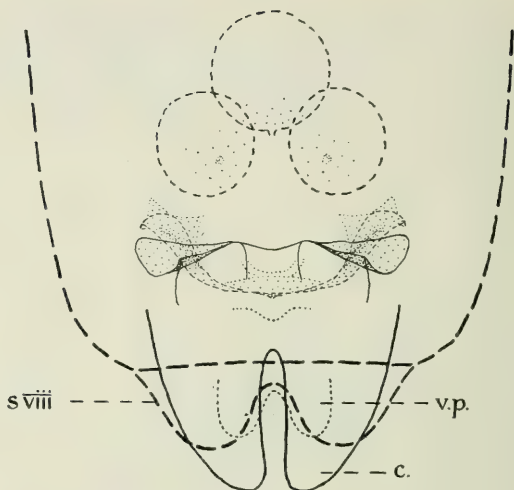


FIG. 21. *Eretmopodites chrysogaster*, Grah., posterior extremity of abdomen of female, dorsal view.  $\times$  c. 185;

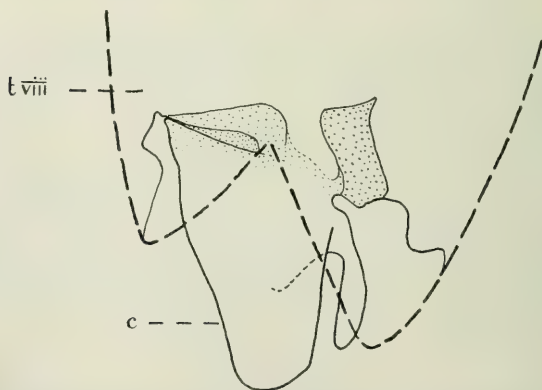


FIG. 22. *Eretmopodites chrysogaster*, Grah., posterior extremity of abdomen of female, lateral view.  $\times$  c. 185.

projecting slightly. Eighth segment not withdrawn within the seventh, sternite projecting slightly further back than the tergite and with its posterior margin deeply notched in the middle. Ninth segment as usual much reduced, chitinised plates rather strong, arranged as shown in the figure. Cerci with blunt or truncated ends; average length about  $200\mu$ , breadth about  $100\mu$ . Ventral process of the tenth segment shorter than the cerci, deeply notched, bearing on each side numerous setae, one pair very strong. Spermathecae three, highly chitinised, sub-spherical; the middle one is the largest and has a diameter of about  $110\mu$  or more, the lateral ones are a little smaller, and are usually, but not always sub-equal, and have a diameter which in the specimens examined ranged from  $91\mu$  to  $114\mu$ , average  $97\mu$ . The commencement of the ducts is chitinised for only a short distance, about  $6\mu$ ; and there are a few pale spots round it at the base of the spermathecae.

*E. quinquevittatus*, Theo. (fig. 23). One specimen. Apparently

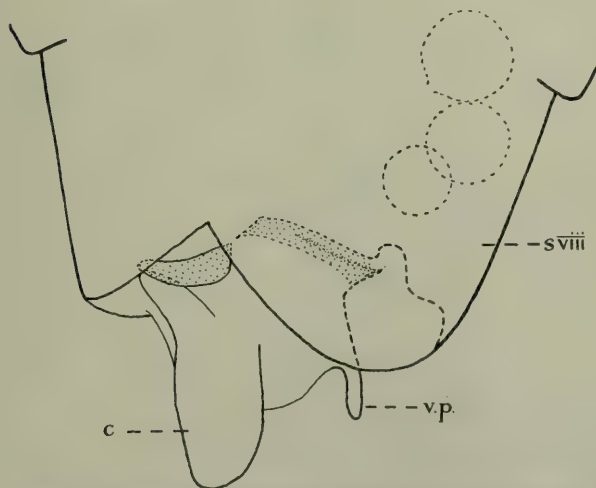


FIG. 23. *Eretmopodites quinquevittatus*, Theo., posterior extremity of abdomen of female, lateral view.  $\times c. 185$ .

almost indistinguishable from *E. chrysogaster*; but in the specimen examined the cerci were slightly smaller, about  $170\mu$  by  $87\mu$ , and so were the spermathecae, the diameters of which were about  $72\mu$ ,  $91\mu$ , and  $68\mu$  respectively, and no part of the ducts appeared to be chitinised.